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Economical mechanisms for renewable energy stimulation in Ukraine

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ABSTRACT

The paper reports main problems of stimulating development of renewable energy in Ukraine. The authors consider presented state mechanisms for maintenance of the green energy where the most effective tariff is the feed-in tariff (functions in Ukraine from 2009). The changes in the active laws and the results of effect of the regulation policy on the development of renewable energy are described. The principal challenges of the law regulation relative to the renewable energy projects as well as proposals for improving the present policy are also discussed.

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1. Introduction

The necessity of enlarging the part of renewable energy in the energy balance of Ukraine is caused by the negative trends in the fuel and energy complex of the country, in particular, by the absence of the supply diversification from the various origins of the fuel.

Despite the fact that the Ukraine is one of the most powerful electricity exporters in Europe (9.745 billion kWh were exported in 2012 [1]), the country faced with increased risk threatening its own energy security [2]. Some reasons are as follows: (1) the economy of the state is one of the most energy-consumed systems in the world. Specific consumption of electrical energy relative to the GDP is 2.5 times larger than the average consumption in the world [3]; (2) the energy losses under transportation are 2 times higher than for the states – members of Organization for Economic Co-operation and Development [4]; (3) during 2010–2012 Ukraine had difficulties with supplies of natural gas from the Russian Federation because of enormous price for 1000 m^3 (more than 400 USD/1000 m^3) [1,5].

The in-country attempts to begin the supplies diversification for Ukraine or to start the mining operations by itself were

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unsuccessful. Nevertheless, the first import of the natural gas from Germany made it possible to reduce the price for 1000 m^3 down to 390 USD [1].

The new contracts on the shale gas mining operations signed by the Government of Ukraine (Shell, Shevron) were unambiguously accepted in the society due to higher ecological risks under mining operations. The shale gas mining operations can reduce the green energy demand.

The negative role is also played by the high depreciation of energy plants of Ukraine [6,7]. The high depreciation of the nuclear reactors is very important; the modernization and replacement of the old-fashioned equipment in 2025–2035 years will require sufficient investments, about 170 billion EUR up to 2030 [8]. Besides that, the future renewable energy will reduce the negative effect on the environment and contribute to eliminating possible climate changes.

So, the development of the renewable energy resources seems to be very important for overcoming the energy crisis in Ukraine.

2. Potential of the renewable energy in Ukraine

As reports the Energy Strategy of Ukraine (ESU) [9], total annual technically achievable energy potential of the renewable energy in Ukraine is about 98 million tonnes of oil equivalent (TOE) or 540 billion kWh (32.4% of the total energy consumption in Ukraine in 2030 as forecasting according to the basic scenario, Table 1).

At the same time, the economically achievable renewable energy potential is 35.53 million TOE/year (Table 2).

As it is seen from Table 2, the forecasting share of the energy production using the renewable energy in 2010 should be 1.8% (according to the basic scenario of ESU). However, this value was about 0.1% at the end of 2010. At the end of 2011 the share of renewable energy in the general balance of primary energy resources of Ukraine was about 0.14% (Fig. 1) [1].

As is shown in Fig. 1, the natural gas is the most usable energy resource (37.2% in 2011), the coal share was 31.1%, the nuclear power plants supplied 19.1% of the primary energy production, and the share of the renewable energy was negligible.

These data indicate very low level of use of renewable energy in Ukraine. In European states in 2011 the share of renewable energy was 47.6% in Sweden, 23.5% in Denmark, 30.9% in Austria, 13.3% in France, 12.3% in Germany, 10.3% in Poland, and 3.8% in United Kingdom [10].

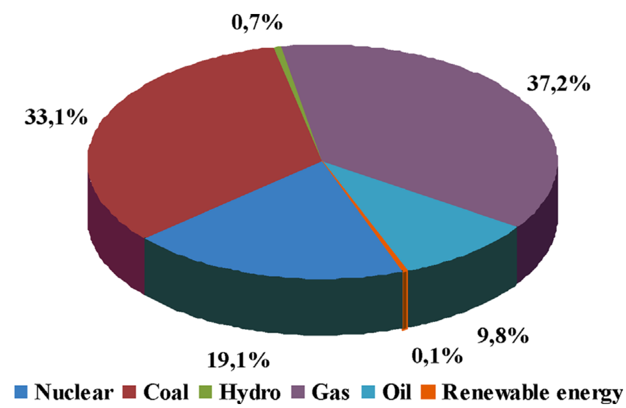


Fig. 1. Primary energy resources in Ukraine, 2011 (%) [1].

Table 1
Energy potential of renewable energy in Ukraine [9].

Directions of developing renewable energy	Annual technically achievable energy potential (per year)		Part of the total energy consumption in 2030 (forecast), %
	billion kWh/year	million TOE/year	
Wind energy	79.8	28.0	9.25
Solar energy	38.2	6.0	1.98
Small hydroenergy	8.6	3.0	0.99
Bioenergy	178	31.0	10.24
Geothermal heat energy	97.6	12.0	3.96
Energy stored in environment	146.3	18.0	5.95
Total	548.5	98.0	32.4

Table 2
Forecast about development of the renewable energy in Ukraine [9].

Directions of developing renewable energy	Development of renewable energy million TOE/year					
	2010	%	2020	%	2030	%
Wind energy	0.21	0.1	0.53	0.22	0.7	0.23
Solar energy	0.03	0.02	0.28	0.12	1.1	0.4
Small hydroenergy	0.52	0.3	0.85	0.34	1.13	0.4
Bioenergy	2.7	1.3	6.3	2.57	9.2	3.04
Geothermal heat energy	0.08	0.004	0.19	0.08	0.7	0.23
Energy stored in environment	0.3	0.1	3.9	1.6	22.7	7.4
Total	3.84	1.8	12.05	4.93	35.53	11.7

3. Law base and state institutions governing of the renewable energy sector

The state institutions governing the sector of renewable energy in Ukraine are as follows: Parliament of Ukraine, Government of Ukraine, National Electricity Regulatory Commission of Ukraine and State Agency on Energy Efficiency & Energy Saving of Ukraine (Table 3).

Nowadays the main laws governing the sector and the market of green energy in Ukraine are as follows: Law of Ukraine "On Electric Power Industry" [11], Law of Ukraine "On Alternative Sources of Energy" [12], Law of Ukraine "On Energy Saving"[13], and Law of Ukraine "On Alternative Fuels"[14]. The priority in defining of future trends in development of alternative energy up to 2030 is given to Energy Strategy of Ukraine envisaging the accelerating development of the sector and maximum energy supplies from the own energy resources. The State Target Economic Program for energy efficiency and development of energy production from renewable energy sources and alternative types of fuel for 2010–2015 provides financial support of high effective development of the renewable energy in Ukraine [15].

4. Economical mechanisms of stimulating green energy development

There are some positive examples of the state support for the development of renewable energy in Ukraine. The main economical mechanisms are the following:

- encouragement of energy production with the feed-in tariff (see Section 4.1);
- tax and custom facilities (see Section 4.2);
- preferred treatment of connection to the electrical network (see Section 4.3);

Table 3
State institutions governing the renewable energy in Ukraine. .*Source*: made by author based on the current legislation in Ukraine

State institutions	Authorities
Parliament of Ukraine	– Defines main directions of the state policy in the sector of renewable energy – establishes main rights and obligations of market participants, guaranteed minimum feed-in tariff, etc.
Government of Ukraine	– Realizes the state policy in the sphere of renewable energy – develops procedures for the changes of share of raw materials, building materials, scope of work and service of Ukrainian origin in the value of energy plants building – approves the scope of production which is imported to the territory of Ukraine in the privilege way, etc.
National Electricity Regulatory Commission of Ukraine	– Confirms the feed-in tariffs for electricity generated from renewable energy sources – forms and provides a registry of the plants of renewable energy – licenses the electrical energy production from the renewable energy plants and its supply as a whole – establishes rules of connection of generating equipment to electrical networks, etc.
State Agency on Energy Efficiency & Energy Saving of Ukraine	– Provides realization of effective state policy in the sector of renewable energy

Table 4
Feed-in tariffs for energy plants using renewable energy resources (April 2013) [16].

Plants of electric power industry using renewable energy sources	Feed-in tariff's coefficient	Minimum fixed feed-in tariff, USD, kWh
Solar energy plants placed on the Earth surface	4.8	0.63
Solar energy plants on building facades/roofs with the power is not exceeding 100 KW	4.4	0.57
Wind energy plants with the power more than 2 MW	2.1	0.15
Biomass-using-based plants	2.3	0.17
Small hydro-power plants	0.8	0.11

- stimulation of domestic production of equipment and components for the plants of renewable energy (see Section 4.4);
- stimulation of electricity generation from the renewable sources by the private households (see Section 4.5).

4.1. *Feed-in tariff*

According to [11] the feed-in tariff is a special price for purchase of electricity generated by plants using the alternative energy resources (excluding the blast-furnace and coke oven gas and this price is also valid for hydro-plants with power no more than 10 MW).

There are two sets of the renewable energy resources:

(a) law-based minimum feed-in tariff is defined for solar, wind and small hydro-power plants, energy generated from biomass of completely or partly vegetable origin. The fixed feed-in tariff is exclusively designed for electro-plants using biomass as a fuel for transformation of its energy. Table 4 lists minimal feed-in tariffs for renewable energy [16].

(b) The electric power without minimum feed-in tariff. In this case the feed-in tariff is determined by the State Agency on Energy Efficiency & Energy Saving and is dependent on various economic factors.

When using two or more renewable energy sources the producer needs to receive feed-in tariffs for each energy source.

Plants combining traditional and renewable energy sources have no feed-in tariffs.

The feed-in tariff in Ukraine is one of the highest in Europe. For example, in the United Kingdom the solar energy feed-in tariff is 0.1–0.22 USD/kWh, which is 3–5 times lower than feed-in tariffs for solar energy in Ukraine [17]. The reason for this is economical instability in the country. According to [18] the feed-in tariffs will be decreased from 10% in 2014 down to 30% in 2024.

The scheme of the state economic stimulation of electricity generation with the help of feed-in tariff is setting up till January 1, 2030 and is spreading to the economical agents, which generate electricity from the renewable sources on the generated plants, implemented into the service within the period of its validity. The government guarantees purchases of the whole volume of the electricity generated from the renewable sources, during the term of order of stimulation validity and the payment of such energy in the total volume.

According to [11], the electricity, according to the feed-in tariff, is subjected to be sold at the wholesale market of electricity of Ukraine. The function of other wholesale markets of electricity in Ukraine is forbidden. The wholesale market of electricity has to buy electricity from the plants which are functioning under the feed-in tariff, all of the electricity generated at the plants of electricity generation industry which use the renewable sources. Finance of the feed-in tariff is not foreseen by Ukrainian legislation and special forces that is why the state enterprise "Energorynok" has to plan its work in such a way and provide financial support of payment according to the feed-in tariff, in particular by means of setting up appropriate sell prices of electricity to other providers.

The law of Ukraine [11] does not contain any principles concerning possible realization according to the feed-in tariff of electricity generated from the renewable sources within the treatments with the consumers. Alongside with it, according to the Law, the consumer of such electricity is provided a document from the governmental establishment, authorized by the Government of Ukraine that confirms the purchase of electricity generated from the renewable sources. However, neither the authorized body nor the procedure of the document used are set up by the preset legislation, which means that the State Authority does not set up any economic or administrative stimuli for purchasing the electricity by the consumers with the high feed-in tariff.

4.2. *Tax and custom facilities*

Tax codex of Ukraine proposes the following facilities:

- no Value Added Tax (VAT) and custom payments for imported equipment, materials and components used for green energy

generation in case when these items are not produced in Ukraine;

- no VAT payment for plants generating green energy up to 10 years beginning from 1.01.2011;
- no additional tax (3% from the price of in-fact electricity generated) in case of selling green energy outside the wholesale electricity market of Ukraine;
- 75% lowering land-tax for territories used for constructing plants which generate green energy;
- lowering rental payment for territories used for constructing plants which generate green energy: no more than 3% year of standard estimation, unlike the 12% yearly payment for territories of state and municipal property [19].

4.3. *Preferred treatment of connection to the electrical network*

The financial support will be divided in to 50% from the funds for electricity transportation and 50% from the "reverse" fund of the manufacturer designed for the transportation organization; the "reverse" fund is to be given back in 10 years [20].

4.4. *Stimulation of domestic producing equipment and components for green energy plants*

According to [11,21] it is mandatory to purchase goods and services of Ukrainian origin for realizing projects pretending to feed-in tariff. The specific weight of the local share for plants starting in 2012 is 15% of the total construction price, 30% in 2013, and 50% in 2014. The solar energy plants have to purchase a minimum 30% of domestic solar modules (start point in 2013) and 50% for plants beginning from 2014 and later.

It is worth noting that Ukraine is making its first good steps to the dynamical development of solar energy using its own natural potential. The most successful firm JSC "Pillar" (Kiyv) exports silicon monocrystalline ingots and wafers. The Q-Cells (Germany) is among the customers. The serial production of solar cells and batteries is also realized by PJSC "Kvazar" (Kyiv). The potential power of producing photoelelements and modules is more than 30 MW. This concern has complete infrastructure – from scientific investigations to industrial production under good production capacity and in the presence of good investments to give Ukraine a good possibility for winning a better position in the world market of solar energy components.

Production, mounting and service of wind energy equipment in the Ukrainian market are presented by the firm Fuhrlaender Windtechnology (Germany-Ukraine), Kramatorsk city.

4.5. *Stimulation of electricity generation from the renewable sources by the private households*

According to the changes introduced by the Law [11] concerning the electricity generation from the alternative sources, from January 1st, 2014, the owners of the private houses are allowed to set up solar power plants on the roof connected to the common power supply network with a capacity no more than 10 kW. Private households generating electricity with the help of solar panels will be able to sell non-consumed electricity to the licensed energy suppliers according to the feed-in tariff.

It is required that the obligatory local component does not spread to the domestic solar power plants. Also the household must not have the license for this type of activity (similar to those which are required by the energy plants).

Feed-in tariff to the electricity generated by the generating units of private households is set up as the single one.

5. Effect of regulation policy on the development of renewable energy market

Successful introduction of the first steps of the state support has resulted in activation of the renewable energy sector in Ukraine.

Thus, the total number of renewable energy plants at the end of 2012 was 32.1% higher than in 2011 and more than 2.6 times higher than in 2009 (Fig. 2) [22].

Besides that, there are projects of solar energy with 1000 MW power and wind energy projects with 3000 MW power which are now under construction. The total power of complete plants in the renewable energy sector was 649 MW at the end 2012, which is 6.4 times higher than in 2009 (Fig. 3) [22,23].

The total generation of green energy in 2012 was 784.7 million kWh, is 2.4 times higher than in 2011 and about 11 times higher than in 2009 (Fig. 4) [22].

On the other and, introducing economical stimuli for development of green energy and announcing long-time goals in developing the sector allowed Ukraine to obtain 31st position (Fig. 5) among the 40 top-states of Europe with the best conditions for green investments (February 2013) [24].

However, despite the rather dynamical development of the renewable energy market in Ukraine, the share of green energy in total electrical balance of the state remains low and was about 0.45% at the end of 2012 [25].

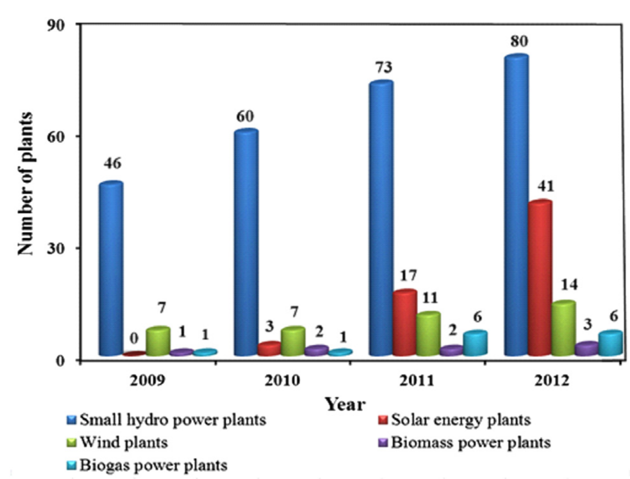


Fig. 2. Number of plants of renewable energy in Ukraine [22].

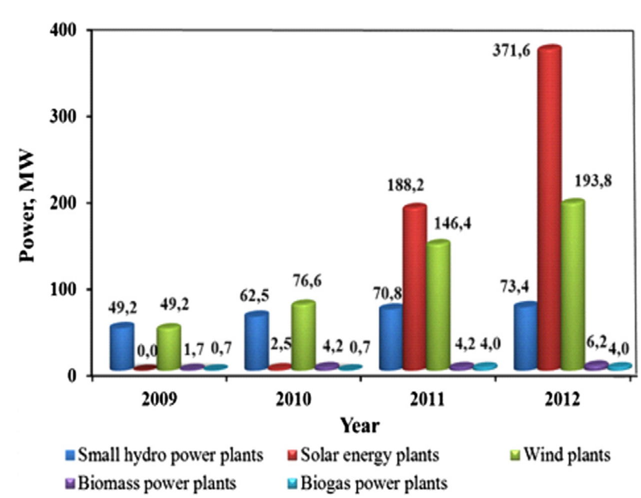


Fig. 3. The available power of the renewable energy plants in Ukraine (MW) [22].

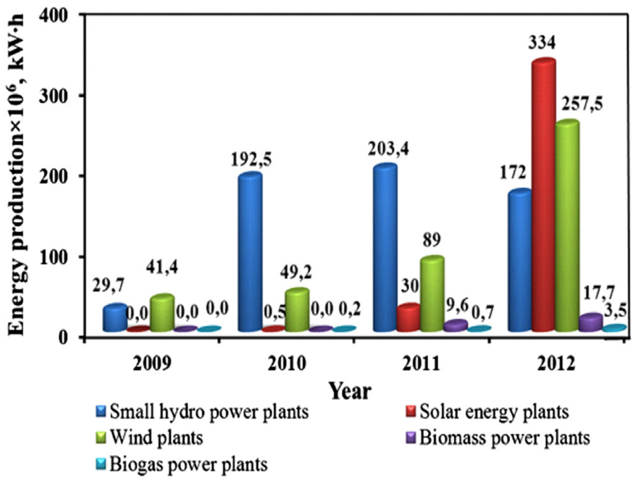


Fig. 4. Energy production from the renewable energy sources in the Ukraine ($\times 10^6$ kWh) [22].

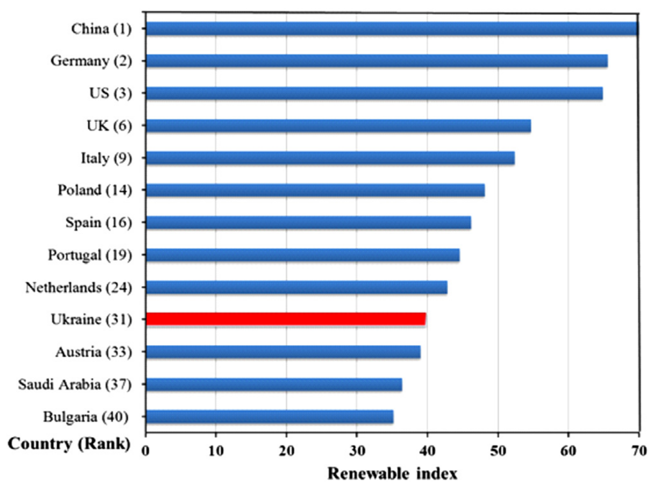


Fig. 5. Indices of the investment attraction of different states for the development of the renewable energy [24].

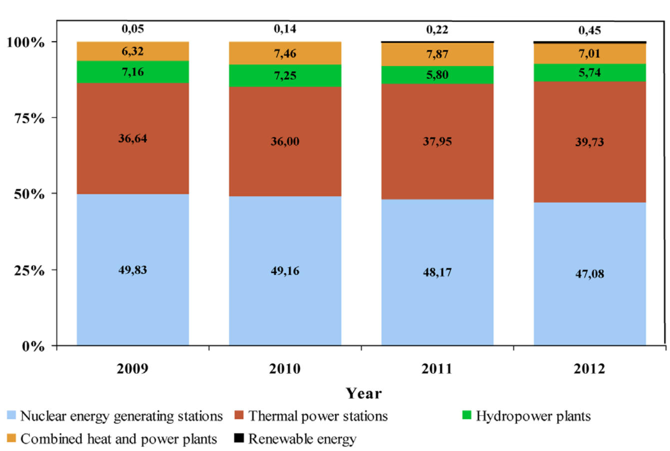


Fig. 6. Dynamics of the main components of electrical balance in Ukraine, % [25].

As is seen from Fig. 6, the energy generation in Ukraine is based on nuclear energy (47.1% in 2012) and on carbohydrate energy resources (46.7% in 2012). The contribution of renewable energy resources remains very low. So the sector regulation policy has sufficient improvement potential.

6. Disadvantages of state policy for stimulating the sector and possible ways of their remedial action

One can point out the following obstacles impeding the development of the green energy sector:

- Lack of entire law base for developing resources of renewable energy providing restriction of using traditional energy sources and lowering prices for green energy.
- Lobbying carbohydrate and nuclear energy and neglecting the ecological part of the price for such energy. None of the European states has such a high difference in tariffs for traditional and renewable energy (0.026 USD for 1 kWh of nuclear energy and 0.62 USD for 1 kWh of green energy in Ukraine) [26].
- Lack of introducing positive international experience in development of green energy, in particular, slowdown of application of green certificates, bonuses, grants for electricity generated from the renewable resources, tenders for constructing the green energy plants, etc.
- The grave disadvantage is also the revocation of right from the plants using traditional and renewable energy to pretend on green tariffs. It could be possible to establish dynamical feed-in tariff according to the share of renewable resources in order to stimulate wide generation of green energy.
- The state guarantee in application of the current feed-in tariffs becomes valid only after finishing the construction of generation plants, but not along with the start of the building. It causes the risks of rejecting the tariff before finishing the plant construction.
- Taking into account the absence of a good network of plants specializing in working-out and producing equipment and components for plants based on renewable energy one should say that the request of mandatory purchasing ware and services produced in Ukraine for realizing projects which define the feed-in tariff may cause definitive obstacles in their manufacturing application. This problem could be solved by alternating the value of feed-in tariff: higher price for energy projects with low local components and lower price for the projects with higher local components. Lowering or postponing the feed-in tariff value for a period of time necessary for starting production of equipment and components for plants could also be an alternative solution to the problem.
- Persistent lack of financial support of projects in the field of renewable energy.
- Absence of the population stimulation in consuming ecologically pure electricity.

7. Conclusions

The data obtained under the investigation presented here allow one to conclude that the Ukraine has a considerable potential for the development of alternative energy. The generation of green energy had increased in last years; in 2012 this value was 784.7 million kWh, – which is 2.4 times higher than in 2009. However, the green energy contribution towards the total energy balance of the state is very low, only 0.1%. Analysis of the presented structure for governing the system of renewable energy shows failure to a determine of ways to develop the sector of renewable energy corresponding to needs of the economy and society. So, the objective need of improving organizational economical mechanism of stimulation of the sector of renewable energy in Ukraine is to be satisfied along with working-out novel technologies of generation, storage and transportation of the green energy.

References

[1] Energy balance of Ukraine [Internet]: State Statistics Service of Ukraine. c1998 – [updated 2012 November 20; cited 2013 March 12]. Available from: ⟨http://www.ukrstat.gov.ua⟩.
[2] Balmaceda MM. Energy dependency, politics and corruption in the Former Soviet Union: Russia′s Power, Oligarchs′ Profits and Ukraine′s Missing Energy Policy. London: Routledge; 2008.
[3] International Energy Agency. Key world energy statistics 2012. Paris: IEA Publications; 2012 (80 pp.).
[4] Begun SV, Vorontsov SB. Sotsialno-ekonomichni aspekti tsinovoyi politiki v energetitsi Ukrayini. Strategic Priorities 2012;2(23):31–8 (in Ukrainian).
[5] European Commission: Directorate General for Energy. Quarterly report on European gas markets. Brussel: Market Observatory for Energy; 2012 September Report No.: Vol. 5, p. 2-3.
[6] Sabadash V. Ukraine's energy security: threats of conflict and cooperation opportunities. Sci J Riga Tech Univ 2011;28:31–5.
[7] Maysner F., Ukerdt F. (BE Berlin Economics GmbH) Rozvitok vidnovlyuvalnih dzherel v Ukrayini: potentsial, pereshkodi i rekomendatsiyi shchodo ekonomichnoyi politiki; Final report. Berlin: GTZ; 2010 November in Ukrainian.
[8] International Energy Agency. Ukraine 2012. Paris: IEA Publications; 2012 (224 pp.).
[9] Energy Strategy of Ukraine till 2030 for the Period until 2030. Ukraine government prescription no. 145-pp; March 15, 2006.
[10] European renewable energy share increases to 13.4% in 2011 [Internet]: EurObserv′ER. c1997 [updated 2012 December 12; cited 2013 March 14]. Available from: ⟨http://www.eurobserv-er.org⟩.
[11] Law of Ukraine "On Electric Power Industry", Pub. L. No. 575/97-BP; October 16, 1997 in Ukrainian.
[12] Law of Ukraine "On Alternative Sources of Energy", Pub. L. No. 555-IV; February 20, 2003 (in Ukrainian).
[13] Law of Ukraine "On Energy Saving", Pub. L. No. 74/94; July 01, 1994 (in Ukrainian).
[14] Law of Ukraine Law of Ukraine "On Alternative Fuels", Pub. L. No. 1391-XIV; January 14, 2000 (in Ukrainian).
[15] On approval of the State Target Economic Program on energy efficiency and the development of energy production from renewable energy sources and alternative fuels for 2010-2015, Ukraine government prescription No. 243; March 01, 2012 (in Ukrainian).
[16] On setting the "feed-in tariffs" for May 2013. Prescription of National electricity regulatory commission of Ukraine No. 492; April 25, 2013 (in Ukrainian).
[17] Tariffs payable per kWh of electricity produced [Internet]. London: Feed-In Tariffs Ltd.; c2000 [updated 2013 Apr 01; cited 2013 May 03]. Available from: ⟨http://www.fitariffs.co.uk/eligible/levels⟩.
[18] Sysoiev M. Ukraine looking to renewable future. Renew. Energy Focus 2012;13 (3) (18-2).
[19] Law of Ukraine "Tax Code of Ukraine", Pub. L. No. 2755-VI; December 02, 2010 in Ukrainian.
[20] Law of Ukraine :On Amending Certain Laws of Ukraine regarding fees for joining networks of natural monopolies:, Pub. L. No. 5021-VI; June 22, 2012 (in Ukrainian).
[21] Renewable Energy Policy Network for the 21st Century. Renewables Global Status Report 2012. Paris: REN21 Secretariat; 2002 December.
[22] National electricity regulatory commission of Ukraine. Report on the development of renewable energy sector in Ukraine. Kiyv: NERC; 2013 March, Report No. 1854/23/47-13 (in Ukrainian).
[23] Greenpeace International, Global Wind Energy Council. Global Wind Energy Outlook 2012. Annual report. Beijing: GWEC; 2012 (November).
[24] Warren B. All renewables index (ARI) at February 2013. RECAI; 2013: 36; 16-3.
[25] National electricity regulatory commission of Ukraine. Final report on operating results in 2012. Kiyv: NERC; 2013 March, Report No. 282. (in Ukrainian).
[26] Analysis of prices formed on the wholesale electricity market from 11 to 20 April 2013 [Internet]. Kyiv: DP "Energorinok"; c2002 [updated 2013 April 21; cited 2013 May 03]. Available from: ⟨http://www.er.energy.gov.ua⟩ (in Ukrainian).